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Stemming the Tide: Retaining and Supporting Science Teachers

Abstract

Chronically high rates of new and experienced science teacher attrition and the findings of new large-scale mentoring programs indicate that administrators should adopt new approaches. A science teacher's role encompasses demanding responsibilities, such as observing laboratory safety and OSHA mandates, as well as management of a business-like, yet engaging, hands-on classroom environment. When added to the challenges experienced by all new teachers, these science-specific challenges can contribute to a science teachers' decision to abandon teaching. This study summarizes data from reports of the US Department of Education, state, other federal, private and professional societies on teacher attrition and new mentoring models. It describes successful features of programs and recommends how they can be delivered economically. When senior-level science teachers are provided pay incentives and some release time, they can become discipline-specific mentors, helping to ensure successful retention of new teachers and providing motivation for experienced teacher to postpone leaving. Pairing experienced science teachers, using electronic media, providing recognition, providing additional time or assistance to gain control of the laboratory, and supporting new teachers in joining appropriate professional groups are strategies described in this paper.

Introduction

Why do America's 12th graders' continue to fail science achievement tests in spite of increases in state-mandated achievement standards, graduation requirements, and learning resources? Darling-Hammond reported in 2000 that students of experienced subject-matter specialists achieve at a higher level than those students with new or underprepared teachers, or those teaching outside their field, while the schools with the worst performance on annual report cards are those with the highest faculty turnover. If this continues to be the case, and we wish to improve student achievement in science then it is important to address the science teacher shortage.

Keywords: science teacher attrition, science teacher supply, science teacher mentoring

Persistent and unacceptably high rates of science teacher attrition and the shortage of new teachers are plaguing the profession (Hampden-Thompson, Herring, & Kienzi, 2008; Ingersoll, 2007; Henke, Zahn, & Carroll, 2001). A serious science teacher shortage exists across the United States while the National Center for Educational Statistics (NCES) predicts record school enrollments each year for the next decade (Snyder and Dillow, 2010), indicating the shortage will continue. Also according to NCES, the shortage has resulted in 60-70% of earth science, chemistry and physics or physical science classes being taught by teachers without an in-field major, a minor, or a certificate in a science discipline (2010). According to the United States Department of Education (USDE), nearly 30% of science classes are taught by physical education, social studies, or "other" teachers (Seastrom, Gruber, Henke, McGrath, & Cohen, 2004). If American students are to achieve in the sciences, we must attract and retain qualified physics, earth science, chemistry, and biology teachers. The purpose of this article is to respond to the supply and retention problems in the science teaching profession with a practical solution.

Issues for New Teachers

In "*Becoming a Teacher*," Fuller and Brown (1975) described three developmental stages teachers experience as they adjust to the demands of the profession. The stages are:

- concern for survival (*Survival Stage, p. 38*),
- concern for self-adequacy (*Limiting Context Stage, p. 39*), and
- concern for teaching impact (*Concern for Student Stage, p. 39*).

Thirty to fifty percent of new teachers get stuck at the anxiety-ridden *Survival Stage,* fail to bond to the school community and abandon teaching during their first three years (Hampden-Thompson, Herring, & Kienzi, 2008). Moreover, a disproportionate number of science teachers retire during early middle age for other opportunities, perhaps as a result of having lost the sense of being valued for their contributions within the academic community (Snyder & Dillon, 2010; Hampden-Thompson, Herring, & Kienzi, 2008; Martinez-Garcia & Slate, 2008).

While it is true that science teachers have other career options that their colleagues in mathematics and humanities may not, the principal reason they leave is job dissatisfaction (Hampden-Thompson, Herring, Kenzi, 2008; Harris Interactive, 2010). Classroom management for chemistry, physics, earth science, and biology teachers extends beyond what other teachers deal with, to include:

- planning the laboratory experience;

- maintaining the laboratory space and inventories;
- guarding the storage, safe use, and disposal of chemicals and specimens;
- controlling hazardous substances, following OSHA and NIOSH workplace regulations;
- and purchasing equipment and consumables

(Herr, 2007; National Science Teachers Association, Board of Directors, 2000).

Science teachers of all levels report feeling isolated from colleagues, becoming bored, and wishing for more input into school decision-making (Roudebush, 2010). Teachers, having surmounted early challenges, experience restlessness and a desire for increased opportunities for professional advancement, as reported by Ingersoll (2007) and in findings by Harris Interactive (2010) in the *MetLife Survey of the American Teacher*. The emotional rewards expected from teaching appear to fade.

Issues for Experienced Teachers

Experienced science teachers tend to leave or to retire sooner than their peers. Moreover, the *MetLife Survey* reminds us that the majority of classroom teachers are part of the *baby boom* generation and are reaching retirement age (Harris Interactive, 2010). Understanding that mass retirements will worsen the critical shortage of chemistry, physics, and biology teachers, we are interested in learning what would motivate science teachers to delay retirement. As reported by McElroy for the on-line newsletter of the American Association for the Advancement of Science (AAAS), two noted science educators, Sheila Tobias and Anne Baffert, surveyed 500 secondary science teachers. They were asked about their working conditions, their plans to stay in or leave the teaching profession, and what would *motivate* them to stay. "The results were surprising: science teachers valued recognition as professionals over salary increases," according to Tobias and Baffert (2009). They and others also report job dissatisfaction as the most common reason experienced science teachers leave (Harris Interactive, 2010; Ingersoll, 2007); experienced science teachers often suffer boredom and desire for more control of the school environment, policy, or working conditions. Chemistry, and physics or physical science teachers, in particular, tend to feel lacking in professional opportunities for collaboration, advancement, and academic progress. "The secondary science teacher has the most opportunity to work outside of school of any of the teachers. . . They can go right from school lab into a high-tech industry (McElroy, 2009, para. 14)." Science teachers are trained in lab safety and lab techniques so can adapt to other lab settings; their technical knowledge makes allows them to enter various career paths. The Tobias and Baffert survey, as summarized by McElroy, found also that science teachers craved prestige, control over the pace and content of curriculum, and influence over testing and that experienced teachers who are contemplating retirement say they would remain if they were offered the opportunity to combine teaching with recognition such as more administrative responsibilities (2009). This was supported by the MetLife Survey in 2010. "Three-quarters of teachers (75%) agree that they would like to continue to work in education beyond traditional retirement as, for example, a teacher mentor, administrator, tutor, etc. (Harris Interactive, 2010, p. 48)."

With senior science teachers leaving at younger ages than their peers in other fields, finding efficient ways to stem the loss of talent to the schools seems crucial.

Supporting and Retaining Science Teachers: A Two-Way Support System

How can schools with limited resources improve science teacher retention? While many reports describe the economic and educational impact of teacher attrition, few, if any, consider the particular conditions that result in loss of science teachers or recommend efficient remedies to stem this tide. Studies of effective strategies to retain new and beginning teachers are in progress (National Center for Educational Statistics, 2010), but there is no apparent evidence of efforts to discourage experienced teachers from leaving. What is a practical solution?

The plan proposed here addresses factors described as responsible for driving science teachers away, at the expense of the students they leave behind. With this proposed plan, school administrations provide *new* science teachers with *experienced science* teachers to mentor and assist. A mentor is a wiser, more experienced teacher (with a reduced teaching load), assigned to guide the new teacher through the probationary period, and to observe and provide the new teacher with instructional support and feedback. The mentor's administrative responsibilities will include participation in hiring of new science teachers and sharing in instructional supervision and management of the laboratories. Administrations will also commit to hiring new science teachers as early as possible, and, during the first year, to providing a dedicated science room, allowing time to meet with the mentor, and requiring only one teaching preparation.

Modeled after the medical internship program, districts have been offering new teacher induction programs with assigned mentors; some studies have been conducted to determine induction program effectiveness (Kirk & Olinger, 2003; Knouse, 2001; Heidcamp & Shapiro, 1999). While specific program features vary widely (Smith & Ingersoll, 2004; Ingersoll & Kralick, 2004), induction strategies usually aim to support and retain new teachers and increase new teachers' confidence and effectiveness.

Typically, mentors in district or statewide induction systems are identified as master teachers, but they are not usually selected from the same discipline as the new teacher. Bianchini and Brenner (2010) in their recent study, claim that new teachers working with mentors outside their disciplines found it "of little substantive help in shaping their instruction" (p. 192, 2010). Science teachers would not be surprised by this finding because the demands on science teachers

are so unique. The science laboratory responsibilities are stressful. The beginning teacher has a steep learning curve (Kardos & Johnson, 2007).

A teacher from outside science is unlikely to have science content knowledge or relevant pedagogical or practical experience, while the *experienced science teacher* understands the plight of the *new science teacher*, so is best able to anticipate obstacles and dilemmas (Stroot, et al., 1998).

The induction program described in this paper includes a two-way support system. A sense of belonging to the school community and ownership of student achievement will be shared goals. A mentor, an experienced science teacher, will be involved in the interview and hiring decision, and then immediately begin to collaborate and assist the new teacher. The model is followed in many northeastern states and was described by Bruce Alberts, former leader of the National Academy of Sciences as a "cornerstone of student achievement in science" (Connecticut Science Supervisors Association, 2002). The link between the experienced and the beginning science teachers provides collaborative support and creates a sense of collegiality, which both find important to them as teachers (*Harris Interactive*, 2010; Wood, 1999).

The mentoring arrangement can be both face-to-face and online through an *e-mentoring* affiliation (Pirkle & Peterson, 2009).

Practical Issues

School districts will face a challenge in providing this model (Colley, 2002). What are the constraints? Change is difficult: cost, scheduling, and personnel will be cited as obstacles. The cost of releasing for one period and providing a stipend for an experienced teacher are investments that will be likely to yield improved student achievement, and save the cost of hiring replacement teachers from a very limited pool of available candidates (Darling-Hammond, 2000). Hiring is costly both in terms of time and money. Modifying an experienced science teacher's schedule to permit meeting and supervising the new teachers and managing the laboratories will require changes to the teaching contract. Expanding the role of the department chairperson may be the most reasonable route to take, since most high schools have department chairs who meet monthly with faculty and may have responsibilities for ordering supplies. Adding mentoring, supervising, laboratory management, and hiring responsibilities would be a positive professional career enhancement, satisfying the craving for advancement and recognition. The mentor should also be provided with professional development in educational leadership available at universities either through online or face-to-face classes on college campuses (Berry, Daughtrey, & Wieder, 2010; Stroot et al., 1998). In the case of the rural school or region with low population density, mentoring using new technology may be the creative option.

New technology, such as videotaping and podcasting, or two-way videoconferencing, adds efficiency to mentoring activities (Dabbagh, 2005; Holland & Childress, 2008; Lai & Calandra, 2007; Pirkle & Peterson, 2009), especially if the mentor responds on a blog and also face-to-face. It could be argued that the dialogue will cement the novice's (and mentor's) habit for reflective practice. In addition, one mentor could observe and meet multiple teachers electronically. This is the model that may also be adopted in rural areas where populations are small.

States such as California have state-organized induction programs. Statewide programs can be expensive and serve "a minority of teachers (Halford, 1999, p. 5)". Ingersoll and Kralick reported in 2004 that only "1% of new teachers participated in a full induction program" and the estimated annual cost is $5000 per teacher, no doubt due largely to itinerant mentors' travel costs (2004, p. 13). Having a school-based, discipline-specific mentoring program may cost the school; the savings in retaining both the recently hired and the veteran mentor teacher will likely offset the cost.

Mentoring plus providing a single preparation in his or her discipline, in a dedicated and equipped classroom laboratory, will ensure the best possible environment for new-teacher retention. The affirmation provided to the veteran teacher will help to offset the prime reason veteran teachers give for leaving teaching early , which is a desire for recognition and "a sense of being valued as a professional" (McElroy, 2009, p. 1).

Conclusion

America's 12th graders' continue to fail science achievement tests. An unacceptably high percentage of classes are taught by teachers without a degree or license in the science discipline due to a chronic shortage of highly qualified science teachers and teacher attrition.

Working conditions, lack of participation in decision-making, and lack of access to professional advancement are cited as reasons for novice and veteran

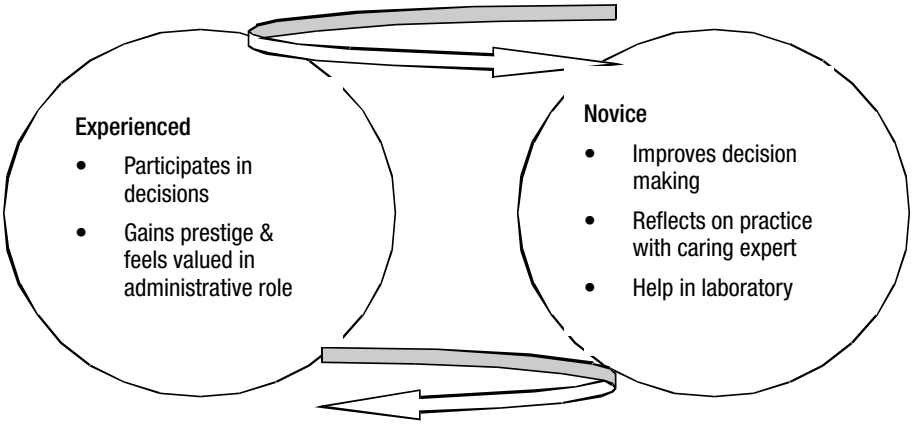

Figure 1. Two-Way Support System

teacher attrition. To address teacher attrition, this paper proposes improvements to working conditions including: discipline-specific, school-based mentors; limiting teaching to the licensed discipline; assigned, equipped classroom laboratories; and hiring early in summer to provide time for orientation.

Mentoring will be of benefit to both novice and the veteran teachers. The veteran teacher who mentors gains affirmation, professional advancement, participation in administrative decisions, and seeing the rewards from guiding a novice through the anxiety-ridden early stages of development in the teaching profession. New science teachers gain the assistance and guidance of the experienced, wiser professional, instructional support and assistance, and diminished isolation. Professional development becomes a two-way street. Providing two-way support between novice and experienced science teachers is predicted to benefit student achievement and ensure the highest quality of instruction.

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